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Regulatory Issues for Mobile Grid Computing in the European Union

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Abstract

While regulatory issues on telecommunications and data handling have been established in a generic and service-neutral manner, typically independent of detailed technical applications or application domains, the uprise of new technology and new systems requires always a revisiting of those regulations. Thus, since the new trend of mobile grids — including an integrated traditional grid computing, knowledge handling, and multi-domain dynamics — has started most recently, a careful analysis of regulatory effects within the European Union (EU) is highly essential for potential new stakeholders.

Therefore, this paper summarizes the most relevant regulatory aspects for mobile grid systems on a EU level, such as contractual agreements, security, and data protection. In this respect, the eCommunications framework serves as the starting point to assess relevance of existing EU regulations. In turn, mobile grid characteristics and respective roles are depicted. This is followed by presenting the eCommunications framework. Finally, those existing regulations are evaluated on how well they reflect relevant aspects of service provisioning in a mobile grid.

1. Introduction

Grid computing, traditionally focused on High Performance Computing (HPC) [2] within research communities, has evolved to service grids introducing service virtualization aspects [19] so that resources are coordinated and services are aggregated across administrative domains. Thus, legally independent organizations form a virtual organization (VO) [18], supported from a technical viewpoint by the use of standard interfaces and open protocols. However, several challenging issues have to be reflected by next-generation grid systems, such as virtualization of high-level resources like knowledge and support of mobile or nomadic users in a commercial environment [22]. These aspects are addressed in the European research project Akogrimo (Access to Knowledge through the Grid in a mobile World) [1] by fostering mobile grids as the standard service delivery platform for telecommunication operators.

When considering commercial service provisioning in a VO for mobile grids, regulatory aspects shape the legal setting to be compliant with. The two key characteristics of mobile grids, multi-domain high-level resource coordination and mobility-triggered dynamics of the organizational composition and business flows, increase the complexity with respect to the implementation and verification of legal compliance across the complete value network. Moreover, various and potentially conflicting demands, *e.g.*, consumer protection, privacy, and promotion of competition, originating from different interest groups have to be met by means of the underlying regulatory framework's determinations. In a mobile grid environment, these stakeholders embrace grid application providers, application customers and end-users, network and grid service providers (including telecommunication operators), as well as the authorities that monitor and regulate the respective markets.

Stakeholder requirements influence the range of potential domain-internal and VO-enclosing opportunities for business flows to be adopted, while services provided have to remain within the limits set by relevant legal determinations. The EU regulatory framework for electronic communications (eCommunications) [5] as the most prominent set of rules in that area covers key aspects to be considered, such as privacy or consumer protection issues. The framework has been enacted in 2003 in order to be implemented in the form of national legislations thereafter. It has been designed with technology-neutral service provision in mind. This objective and the accordingly developed determinations potentially interfere on one hand with technology-driven mobile grid aspects, on the other hand they have to be cross-checked with the respective stakeholder requirements. This affects not only contractual agreements among VO members, either pre-arranged or dynamically negotiated on demand, and technically implemented by Service Level Agreements (SLA) and Service Level Specifications (SLS), but also service delivery in a secure way.

Even though the eCommunications framework is by far not the only rule-set of relevance for mobile grid computing[1] , it forms a major step for a wider range of compliance evaluations, starting from specific concerns, such as available radio spectra for mobile access, up to more general issues, like the very notion of a service. Assessing those and other significant aspects addresses three key checkpoints: On one hand, indications are given on whether the regulatory framework covers grid-based service provision in a meaningful way, on the other hand, an assessment is provided on how well VO stakeholder requirements are reflected in the framework. These efforts result in formalized relations between regulatory principles and correspond to technical characteristics of mobile grids.

The remainder of this paper is organized as follows: While Section 2 summarizes mobile grid characteristics and potential stakeholders involved, Section 3 presents the regulatory eCommunications framework. Those basics lead to the relevance assessment in Section 4, which does discuss the set of currently envisioned effects and problems.

1. Others include — in terms of a non-concluding listing — EU directives 98/48/EC [11], 98/34/EC [10], 2000/31/EC [12], 97/7/EC [8], Council directive 93/13/EEC [6], and Commission directive 2002/77/EC [4].

2. Mobile Grid Characteristics

Envisaging the relevance assessment of regulatory provisions for mobile grids rises the need for an in-depth consideration of mobile grid characteristics. This includes on one hand the differentiation of mobile grid systems from related grid concepts. On the other hand, the suitability of the mobile grid organization model and the relevant set of roles and actors need to be depicted.

2.1 The Evolution of Grid Computing

The main objective of any grid system type is found in sharing networked, potentially geographically dispersed resources, whose utilities are made available by means of standardized interfaces. Traditional grid systems focused mainly on sharing resources in order to solve computationally or data-intensive tasks. To this aim, clusters consisting of relatively inexpensive networked computers and/or storage facilities were used. The grid nodes usually formed one administrative domain, run by a single, typically research-oriented organization. Those first grid systems are called *computational grids* [20] and *data grids* [3], depending on whether such a grid emphasizes more on computational or storage-related issues.

The next evolutionary step in grid systems' development happened on the organizational model that became applicable due to the coordination of resources out of different administrative domains. While resource types remained the same, namely network infrastructure, computational power, and storage facility, this new grid system category introduced a service layer on top of the resource pool across administrative domains. Hence, the novelty of such service-oriented grid systems, called *service grids* throughout this work, consists in forming a virtual organization (VO) [19]. In service grids, various resources are encapsulated by means of grid services — Web Services with well-defined interfaces and following certain conventions [18] — that are in turn made available for authorized VO members. Service grids facilitate computational and data grids to adopt service-orientation concepts, so that these traditional grid systems also profit from grid service provisioning across administrative borders. Inter-domain service provisioning in service grids determines today the state-of-the-art in grid computing not only for community-driven grids, but also for many commercial solutions. However, most of the commercial grid solutions are nowadays targeted towards enterprise-wide implementation, so that they make use of the service-orientation aspect in service grids, whereas rather virtual teams than virtual organizations are built.

Service grid concepts triggered again new challenges to be addressed by so-called next-generation grid systems. Those challenges mostly deal with increased complexity. Most importantly, but in terms of a non-comprehensive listing, this embraces the coordination of higher-level resources, such as knowledge, the support of dynamic virtual organizations (DVO), and the commercialization of grid services. All these aspects are of center stage for the *mobile grid* as it is designed and prototypically implemented in the EU project Akogrimo [1]. Accordingly, Akogrimo blueprints a next-generation mobile grid that sketches a service delivery platform for commercial service provisioning across administrative domains, providing mechanisms to solve complex problems in nomadic or mobile environments.

2.2 Mobile Grids and Mobile Dynamic Virtual Organizations

Mobile grids base on the principles of service grids. Thus, VOs determine a mobile grid's organizational model and resources are encapsulated via services. The main functional extensions over service grids are driven by mobility. In mobile grids, the support of several kinds of mobility, such as user, device, and session mobility, on one hand provokes higher dynamics in the VO with respect to organizational composition. On the other hand, it requires handling of higher-level resources in addition to the traditional coordinated grid resources, network, computational, and storage infrastructure. This additional resource is subsumed under the term knowledge. It includes more specifically user and device context information as well as specifications of adaptive business processes that are initiated or altered based on current context information. Hence, the resource knowledge absorbs the application domain-specific business logic, while it shapes the range of possibilities how to handle context information.

Expanding grid services onto mobile grid nodes suggests to consider both, unlicensed as well as licensed wireless access schemes, so that pervasive access becomes best possible. Mobile grid services make use of mobile IPv6 (Internet Protocol Version 6), whereas grid systems in general are not concerned with layer 2 media access issues. Although a mobile grid does not change this general rule, layer 2-specific considerations gain more relevance with respect to commercialization and regulations. To support licensed media access demands for the inclusion of mobile telecommunications operators into the organizational model. This implies first a clear commercial focus of envisaged mobile grid solutions and it secondly indicates working mass, probably end-consumer markets. On the technical side, a commercial focus asks not only for cross-layer consideration of context elements, but also for an integrated accounting and charging as well as Quality-of-Service (QoS) guarantees from network to application.

In conclusion, the suited organizational model for mobile grids leaves the notion of VOs unmodified, whereas mobility support is perceived as the driver for a row of important challenges that demand for an extended VO model — denoted as mobile dynamic virtual organization (MDVO) and defined as follows: "MDVOs are virtual organizations whose members are able to change locations while provided or consumed services remain available even after temporary loss of reachability, and while running or yet to be initiated workflows adapt to changed conditions, so that MDVOs are characterized by a strong dynamic element with respect to their organizational composition and their business processes" [22].

2.3 Mobile Grid Roles and Actors

With regard to the main aim of this work — assessing the eCommunications regulatory framework on its relevance for

mobile grids — it is of high importance to determine the set of relevant roles and actors in a mobile grid. The role model as depicted in Figure 1 draws basic roles for electronic service provisioning in VOs [21]. It is sufficiently generic to cope also with mobile grids and MDVOs, respectively. The key extensions presented, addressing mobile grids over service grids, are fully in-line with this role model. This is due to the fact that MDVOs only extend VOs. The commercial focus is explicitly expressed while other mobile grid aspects are adopted by specific role instantiations, subsumed under the generic roles shown in Figure 1.

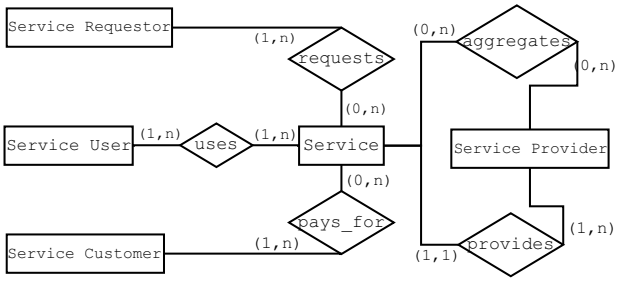

Figure 1. Basic Role Model for Electronic Service Provision in VOs [21]

The basic role model provides for commercial service provisioning, since the roles on the service consuming side differentiate between roles for actors that request, use, and finally pay for the service in question. The coordination of higher-level resources and mobility are not shown explicitly in this basic role model, since it focuses on the generic service provider role only. This generalization is meaningful for a role model that needs to be applicable to many VO or MDVO types, but for the purposes of this work, actors and roles have to be depicted in greater detail.

Consequently, the corresponding organization model has been developed as it is shown in Figure 2. Its main building blocks are the base VO and the operational VO, whereas the latter embraces the first. The base VO comprises pools of potential resources, services, applications, and providers to be combined into an actual instantiation of the VO for one user or one customer. Such an instantiation per user or customer is called operational VO. It represents the currently bound base VO elements and the user or customer together with his or her device, all along with corresponding higher-level resources. These consist of user and device context information as well as state information for the instantiated base VO elements, such as the currently executed business processes in a mobile grid application or QoS measures.

Figure 2 applies a layered approach to depict base VO elements. In accordance with those evolutionary steps sketched in Section 2.1, the basic resource pool embraces the set of typical resources for computational and data grids: network, computational, and storage facilities. These resources are encapsulated by a service layer on top, as introduced by service grids. In contrast to Figure 1, services are differentiated from applications in Figure 2. Applications are perceived to consist of one or more (grid) services, potentially complex services composed from basic services, plus some extra services, *e.g.*, user support. Applications, thus, represent the complete bundle of composed and basic grid and non-grid services that a customer buys. Accordingly, the provider pool

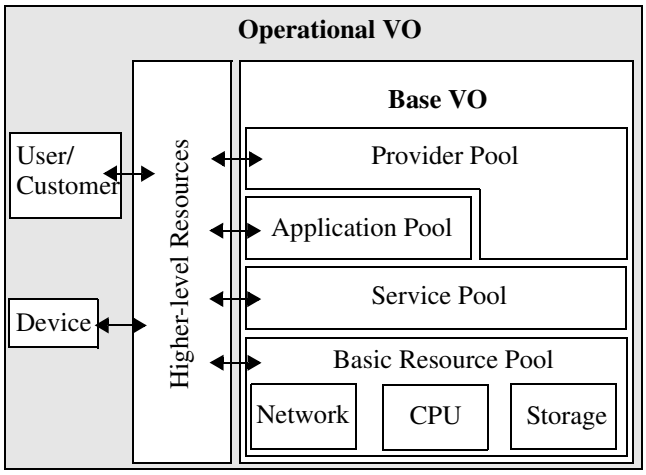

Figure 2. Mobile Grid Organization Model

embraces providers that offer grid services and providers that offer applications. Only the latter are assumed to stand in direct end-user contact by maintaining contractual relationships. The same principle is represented in Figure 1 by the "aggregates" relation.

Those key insights on the suitable role and organization models finally allow for explicitly naming the relevant set of actors and roles in mobile grids. The number of different roles is limited on purpose to the most prominent ones as those roles should be essential for most mobile grids. Highly specific roles might appear in very specific application domains under certain conditions only. In the context of this work, however, an assessment for the majority of mobile grids is envisaged, which leads to the selection of the key roles and actors as listed in Table 1.

3. EU Regulatory Framework for Electronic Communications

Having introduced mobile grids and with those the set of relevant roles and actors leads to the consideration of the EU regulatory framework for electronic communications, called the eCommunications framework. Thus, this section is concerned with the viewpoint of another mobile grid stakeholder: the authorities. For the objectives of this work, EU regulations are in the focus, since Akogrimo as a EU-funded project blueprints a mobile grid with the expertise from 14 European partners.

3.1 Framework Organization

The eCommunications framework consists of five directives, the framework directive 2002/21/EC [15] and four specific directives. The framework directive lists the four specific directives as follows: The authorization directive 2002/20/EC [14], the access directive 2002/19/EC [13], the universal service directive 2002/22/EC [16], and the directive on the processing of personal data and privacy in the telecommunications sector 97/66/EC [9]. The first four directives became effective on April 24, 2002, when they were published in the official journal of the European Union [7]. The latter was replaced on July 31, 2002, by directive

Table 1: Mobile Grid Roles and Actors

Role	Actor
Service User (SU)	These roles can be adopted by either a natural or a legal person. In a Business-to-Consumer scenario, *i.e.*, mobile grid applications are marketed towards end-consumers, a single natural person probably embodies all three roles. In a Business-to-Business environment, however, different natural and/or legal persons likely adopt these roles.
Service Customer (SC)	
Service Requestor (SR)	
Network Service Provider (NSP)	This role is likely to be adopted by a legal person. The most prominent entity acting as a network service provider is a mobile telecommunications operator — especially in a commercial environment with the need for authentication, authorization, accounting, auditing, and charging (A4C) as well as for QoS guarantees.
Grid Service Provider (GSP)	This role can be adopted by either a natural or a legal person. In mobile grids, individuals can act as a grid service providers so that information flows are bi-directional, both towards a mobile grid node and from a mobile grid node. For instance, an individual can publish presence information and perform an expertise on transmitted data, after what the treated information is sent back. This aspect differentiates mobile grids from service grids that incorporate wirefree information access over a portal. In both cases, natural or legal persons, the role of a grid service provider is adopted by an organizational entity equipped with a task-specific competence. By exploiting this competence, the actor delivers basic grid services performed on the set of available grid resources. This includes for instance the delivery of domain-specific content, the analysis of transmitted data or a grid storage service.
Application Provider (AP)	This role is adopted by a legal person. Players acting as application providers dispose of application domain knowledge. They, thus, provide the business logic in a given mobile grid application. They further market the solution towards relevant market segments. This actor potentially profits from partnering with a mobile telecommunications operator. Besides playing the role of a network service provider, the operator qualifies as an optimal partner since it brings in a large customer base, excellent expertise in charging and billing, and potentially experience with systems integration.

2002/58/EC [17], which targets not only the telecommunications sector but the electronic communications sector.

The complete framework is reviewed regularly in order to cope with changed conditions and requirements of involved stakeholders. This includes both, principles and implementation. The first review process started in November 2005, and proposals for modifications are scheduled for the last quarter of 2006.

All directives apply the same structure. After the title section, the complete set of motives that lead to the directive in question is outlined. These motives determine points of consideration so that they define the scope of the directive. Furthermore, they differentiate the directive from related regulations. The motives section is followed by the articles of the directive, constituting the main component of the regulation text. In larger regulations, articles are structured by means of chapters, whereas the first determines scope, aim and definitions, and the last contains final provisions, such as the addressed audience and entry into force. Directives optionally include an annex section where single provisions are specified in further detail or examples are given.

3.2 Framework Directive

The framework directive [15] has been shaped in the light of convergence of telecommunications, media and information technology. Its main aim consists in determining a harmonized legal frame for regulations concerning electronic communications networks and services, and related facilities. It embraces the legal relationship between national regulatory authorities (NRA) and providers of communications networks and services. This includes NRA tasks and applied procedures in order to harmonize the respective regulations EU-wide. Hence, the framework directive defines the legal frame only, that the EU member states have to apply by means of national legislations thereafter.

One of the main design principles in the framework directive and, thus, also of high relevance to the eCommunications framework as a whole, consists in the separation of regulations for transmission and content. The eCommunications framework is not applicable to the content transmitted over communications networks and services. Accordingly, broadcasting content, financial services, or services of the Information Society are not covered by the framework. The decision criterion for including a service into the scope of the eCommunications framework is outlined as follows: Services need to persist completely or mainly of signal transport on electronic communications networks. Voice telephony and electronic mail transmission services fulfill this requirement so that they are covered by the eCommunications framework.

Besides the notion of electronic communications services[1], the framework directive defines “user” and “consumer” which potentially affects the respective understandings of the service user, customer, and requestor roles (cf. Table 1). In the framework, users are perceived as natural or legal persons that use or request a communications service. Consumers are defined as natural persons that use or request a communications service for non-professional purposes. Thus, roles of a service user and requestor are subsumed by the framework’s notion of a user, whereas the role of a service customer is reflected in the framework by consumers, if a Business-to-Consumer scenario applies.

3.3 The Specific Directives

The authorization directive [14] aims at harmonizing and simplifying respective provisions and conditions for receiving the authorization to provide and publicly offer electronic communication networks and services. The main instrument to reach this goal is found in general authorizations. General authorizations establish a framework of national legislations (in accordance with the eCommunications framework) outlining all or sector-specific obligations for the provision of communications networks and services. Thus, by the use of general authorizations, NRAs do not need to apply any further administrative procedure in order to decide on granting or denying authorization. NRAs are requested, but not formally forced, to limit the conditions bound to a general authorization to the absolute minimum possible.

1. This definition determines the general notion of all services covered by the regulatory framework.

The access directive [13] determines provisions for access and interconnection with interoperability and sustainable competition in mind. Access for end-users is excluded explicitly from the directive's scope. Accordingly, rights and obligations for operators, willing to interconnect their facilities, are outlined. The directive covers also tasks and objectives for NRAs. NRAs are required to review imposed regulations on a regular basis. Effected provisions need to be withdrawn as soon as the directive's objectives — mainly with regard to efficient competition on relevant communications markets — have been met.

The universal service directive [16] introduces the concept of the universal service. Universal service means that the minimum set of services defined — with given service qualities — have to be offered to end-users at an affordable price by designated universal service providers. Services embrace only communications services as defined in the framework's directive. Hence, the main aim of this directive consists in the provisioning of a single narrowband connection to the public telephone network. No specific requirements at community level are taken with respect to the required data rate of such a network connection, since the directive is set up in a technology-neutral manner. The universal service directive specifies rights for end-users and according obligations for providers of communications networks and services. NRAs can designate one or multiple undertakings as universal service providers, whereas affordable prices and specific national conditions need to be considered, while distortions of competition have to be avoided.

The directive on privacy and electronic communications [17] is concerned with fundamental rights, in particular privacy in relation to the processing of personal data in the area of electronic communications. In principle, and in accordance with the overall scope of the eCommunications framework, this includes electronic communications services only. In the same sense, the directive defines the term communication. The directive also covers processing of traffic and location data in relation to electronic communications services. Based on the notions of traffic and location data, value-added services are defined as any service — thus, not limited to electronic communications services — that makes use of traffic and location data beyond the level needed for the conveyance of a communication or the associated billing process. Consequently, this directive is the only one in the eCommunications framework to trespass the notion of pure communications services by covering value-added services.

4. Relevance Assessment for Mobile Grids

Driven by those insights gained on mobile grid roles and their actors as well as on the eCommunications framework, Table 2 combines in a precise view the respective viewpoints of all stakeholders involved. This facilitates an in-depth relevance assessment of the eCommunications framework principles and its specific provisions for the determined set of mobile grid roles.

To this aim, Table 2 relates the framework's principles of law with the roles of a service user (SU), customer (SC), requestor (SR), network service provider (NSP), grid service provider (GSP), and application provider (AP). Each principle of law is aggregated from the detailed list of associated provisions. Even though Table 2 is intended to consider the full range of framework regulations, it excludes provisions that are, *a priori*, clearly out of the focus of mobile grids. This affects for instance determinations on subscriber directories, number portability, and pure telephony services in general.

The relevance level for a principle of law is determined by applying the following grading:

- "—", dark grey background coloring: The principle of law in question is not relevant for the considered mobile grid role.
- "(+)", medium grey background coloring: The principle of law in question is only partly relevant for the considered mobile grid role.
- "+", light grey background coloring: The principle of law in question is relevant for the considered mobile grid role.

4.1 Conclusions and Further Work

As shown in Table 2 the key grouping of the set of six roles indicates that the network service provider plays a significant role in all directives: it is affected by all of them. The reason can be found in the eCommunications framework's focus on communications networks and services as defined in the framework's directive. Consequently, the framework provisions are of relevance for the network service provider. This, however, does not imply the conclusion that the eCommunications framework is of global relevance for mobile grids. As developed in Section 2.3 mobile grids follow an integrative approach, trying to integrate resource specifics, thus, also communications networks and services, with grid service and application characteristics. This is implemented technically by middleware services, such as context management and accounting services. Hence, cross-layer issues need to be handled in a consistent way from network to applications, while the network and associated network services form one basic resource in mobile grids only. The role of a network service provider — even though adopting a prominent status in a mobile grid — is not able to cope solely with these aspects. The same argument applies for the overall relevance of regulations for communications networks and services.

In contrast to the network service provider, but in accordance with the previously drawn conclusions, the grid service provider and the application provider seem to be affected by eCommunications provisions at the minimum level only. The only relevant principles of law concern value-added services as covered by [17], general security provisions, and rights of appeal and consultation. As much as regulations on communications networks and services are of importance for network service providers, as few impacts show such regulations on grid services which are based on an all-IP (Internet Protocol) environment. This fact potentially determines an open and unregulated applications and services market, which may, however on one hand, become not controllable due to the lack of relevant regulations ensuring efficient competition and respecting fundamental rights. On the other hand, such unregulated markets in a future mobile

Table 2: Relevance Assessment of eCommunications Framework Provisions for Mobile Grid Roles

	Principle of Law	SU	SC	SR	NSP	GSP	AP
Appeal and Consultation	• Right of appeal: Existence of an appeal body on national level, [15] Art. 4 • Consultation: NRAs grant right to interested parties to comment on draft regulations; [15] Art. 6	+					
Reporting	• Provision of information: Providers of communications networks and services provide requested information to NRA; [15] Art. 5 • Accounting separation and financial reports: Providers of communications networks and services with special or exclusive rights are required to keep separate accounts for those activities; [15] Art. 13 • Information required under the general authorization: NRAs ask only for information that is proportionate and objective for the purposes of a compliance check with conditions or of a market analysis; [14] Art. 11 • Obligation of transparency: NRAs may oblige operators to report transparently and/or by keeping separate accounts in relation to interconnection and access; [13], Art. 9 and 11 • Quality-of-Service of designated undertakings: NRAs ensure that designated undertakings publish up-to-date information on the provision of universal service; [16], Art. 11; QoS measures [16], Annex III	—			+	—	
Harmonization	• Consolidating the internal market for electronic communications: NRAs cooperate with each other and the Commission to ensure consistent application in all member states; [15] Art. 7 • Harmonization procedures: Commission issues recommendation on harmonized adoption of the provisions in the regulatory framework; [15] Art. 19	(+)[a]					
Competition	• Promote competition in the provision of electronic communications networks and services: Maximum user benefit in terms of choice, price, and quality. Removing remaining market entry barriers. Ensure access for all citizens to universal service; [15] Art. 8	+				—	
Resource Allocation	• Management of radio frequencies: Efficient management on national level; [15] Art. 9 • Numbering, naming, and addressing: Managing national numbering plans and global interoperability; [15] Art. 10 • Rights of way: Transparent and non-discriminatory procedures to decide on rights to install facilities on, over or under public or private property; [15] Art. 11 • Co-location and facility sharing: NRAs encourage the sharing of facilities; [15] Art. 12 • Rights of use for radio frequencies and numbers: Member states include the conditions for usage in the general authorization (not bound to individual conditions); [14] Art. 5 • Conditions attached to the rights of use for radio frequencies and numbers: Maximum list of conditions; [14] Art. 6; [14] Annex, parts B and C • Procedure for limiting the number of rights for radio frequencies: If granting of rights needs to be limited, objective, transparent, non-disriminatory, and proportionate selection criteria are adopted; [14] Art. 7 • Fees for rights of use and rights to install facilities: The relevant authority may be allowed to impose fees that ensure the optimal usage of resources; [14] Art. 13	—			+	—	
Significant Market Power (SMP)	• Market definition procedure: Commission defines relevant product and service markets (for communications networks and services) for analysis on players with SMP; [15] Art. 15; [13], Art. 7; list of markets [15] Annex I • Market analysis procedure: NRAs analyze relevant markets on effective competition. If market distortions prevail (players with SMP) regulations are imposed. If market is competitive, existing regulations are withdrawn; [15] Art. 16; [13], Art. 6 and 8; [16], Art. 17; analysis criteria [15] Annex II • Price control and cost accounting obligations: In the case of insufficient competition, NRAs may impose obligations for cost recovery and price controls, including obligations for cost orientation of prices and obligations concerning cost accounting systems; [13], Art. 13 • Carrier selection and carrier pre-selection: Undertakings with SMP are required to enable their subscribers to access the services of any interconnected provider on a call-by-call and pre-selection basis; [16], Art. 19 • Notification, monitoring, and review procedures: NRAs notify the Commission of undertakings with SMP and the respective obligations applied; [16], Art. 36	—			+	—	
Standardization	• Promotion of standards: 1st priority: Standards strictly needed for interoperability and to improve freedom of choice for users. 2nd priority: Standards adopted by European standards organizations. 3rd priority: International standards or recommendations; [15] Art. 17	—			+	—	
Disputes	• Dispute resolution between undertakings: NRAs issue binding decisions; [15] Art. 20 • Resolution of cross-border disputes: NRAs coordinate their efforts; [15] Art. 21	—			+	—	

Table 2: Relevance Assessment of eCommunications Framework Provisions for Mobile Grid Roles

	Principle of Law	SU	SC	SR	NSP	GSP	AP
General Authorization	• Member states ensure the freedom to provide electronic communications networks and services; [14] Art. 3 • Minimum list of rights derived from the general authorization: Provide electronic communications networks and services; negotiate interconnection with other providers; opportunity to be designated to provide different parts of universal service; [14] Art. 4 • Conditions attached to the general authorization: Maximum list of conditions; [14] Art. 6; [14] Annex, part A • Compliance with the rules of the general authorization: If NRAs find that an undertaking does not comply with rules, the undertaking is informed and granted the right to state its views. Potential penalties: Fine; suspend or withdraw rights of use (severe and repeated breach of rules); urgent interim measures (evidence of immediate and serious threat to public safety, security, health or causing serious economic or operational problems); [14] Art. 10 • Administrative charges: Administrative charges imposed on undertakings providing a service or a network under the general authorization only cover administrative costs caused by the general authorization; [14] Art. 12		—		+	—	
Access and Interconnection	• Rights of undertakings: Negotiate on interconnection with other providers; [13], Art. 4 • Powers of NRAs: Impose interconnection where this is not already the case; [13], Art. 5 • Obligation of non-discrimination: NRAs may impose obligations of non-discrimination in relation to access and interconnection, *i.e.*, operators offer the same conditions and qualities to others as for its own services or those of its subsidiaries or partners; [13], Art. 10 • Obligations of access: NRAs may determine obligations for access to, and use of, specific network elements and associated facilities, *e.g.*, unbundled access to the local loop, resale by third parties, access to technical interfaces and protocols, collocation, and interoperability; [13], Art. 12		—		+	—	
Universal Service	• Availability of universal service: Member states ensure availability of universal service at the specified quality[b] for all end-users in the territory, irrespective of geographical location; [16], Art. 3 • Provision of access at fixed[b] location: Member states ensure that connection to the public telephone network at a fixed location is provided by at least one undertaking. This connection enables end-users to make phone calls, facsimile communications, and data communications; [16], Art. 4 • Designation of undertakings: One or multiple undertakings can be designated to provide universal service; [16], Art. 8 • Affordability of tariffs: NRAs monitor the evolution and level of retail tariffs. Obligations may be imposed in consideration of national conditions, including geographical averaging; [16], Art. 9 • Control of expenditure: Undertakings provide services in a way that allows subscribers to monitor and control expenditures; [16], Art. 10 • Unfair burden on undertakings designated to provide universal service: NRAs calculate the net cost of the universal service obligation. Costs may be covered from public funds and/or net cost may be shared between all providers of communications networks and services; [16], Art. 12 and 13; calculation [16], Annex IV • Review of the scope of universal service: Commission reviews regularly the scope of universal service, taking into account mobility[b] and data rates[b] of prevailing technologies; [16], Art. 15; review process [16], Annex V • Contracts: Member states ensure that contracts in relation to universal service contain at least the following elements: identity and address of the supplier, services provided and service quality level, offered maintenance, prices and tariffs, duration of the contract, conditions for renewal and termination, compensation for service levels not met, procedures for settlement of disputes; [16], Art. 20		(+)[b]		+	—	
Personal Data and Privacy	• Traffic data: Traffic data relating to subscribers and users must be erased or made anonymous when it is no longer needed for the purpose of the transmission of a communication. Traffic data necessary for the purposes of subscriber billing and interconnection payments may be processed up to the end of the period during which the bill may lawfully be challenged. If the user/subscriber has given consent, traffic data may be used for marketing electronic communications services or for providing value-added services; [17], Art. 6 • Itemized billing: Subscribers are granted the right to receive non-itemized bills; [17], Art. 7 • Location data other than traffic data: Location data can be processed when made anonymous or with the user's/subscriber's consent for the duration necessary for providing value-added services. Users or subscribers have the right to withdraw consent and to refuse processing of such data temporarily by simple means and free of charge; [17], Art. 9 • Unsolicited communications: The use of electronic mail for the purpose of direct marketing is allowed only with prior consent of subscribers.				+		

Table 2: Relevance Assessment of eCommunications Framework Provisions for Mobile Grid Roles

	Principle of Law	SU	SC	SR	NSP	GSP	AP
Security	• Integrity of the network: Member states take all necessary steps to ensure the availability of the public telephone network and publicly available telephone services at fixed[b] locations; [16], Art. 23 • Security of services and network: Providers of communications services are required to take appropriate technical and organizational measures to safeguard security of their services, if necessary in conjunction with providers of communications networks with regard to network security. In case of a security breach risk, subscribers must be informed about the risk and any possible remedies, including potential costs involved; [17], Art. 4 • Confidentiality of the communications: Member states ensure the confidentiality of communications and the related traffic data; [17], Art. 5	+					

a. Only of importance if mobile grid services are offered EU-wide.

b. Even though specific requirements on minimum data rates are not set within the directive, universal service envisages narrowband Internet access only (56 kbit/s explicitly mentioned in [16], motive 8), which is clearly insufficient for the provision of mobile grid services that partly rely on multi-media content transmissions. Further, guaranteed provision of universal service at fixed locations only does not enable mobile access.

grid environment will serve as a challenge for new business opportunities and chances for a European leadership in mobile grid services. In fact, these considerations suggest the direction of further work in the area of European regulations with regard to services that are not covered by the eCommunications framework. This affects in particular services of the Information Society as defined in [10] and [11]. These services feature the four key characteristics as follows: Information Society services are provided "at a distance" so that the involved parties are not present simultaneously. Service provision takes place "by electronic means", and the services are offered "at the individual request of a recipient of services". In addition, such services are "normally provided for remuneration", meaning that service usage is compensated in terms of money. These characteristics apply in the first place also to user-requested commercial mobile grid services, thus, determining the primary field for further investigations on relevant regulations.

Service users, service customer, and service requestor, finally, serve as typical roles as within other domains and markets, since these roles are affected by the eCommunications framework whenever end-user or consumer viewpoints come into picture. This is the case for general, cross-section determinations, such as security and privacy issues. Seen from the application and services angle, however, only side-aspects are covered by the eCommunications framework. For instance, contractual determinations are an important means to ensure legal certainty for consumers, but in the framework, only contracts with respect to communications networks and services are envisaged.

This leads to the overall conclusion that the eCommunications framework determines partially relevant regulations for mobile grid roles and actors only. It fails to cope integratively with the complete role set for mobile grids. While other European regulations, in particular with regard to Information Society services, determine the range of future work, the limited relevance of the eCommunications framework implicates that the full set of key regulations consists rather of single, collected directives than of one regulatory framework. This implies the potential for partially open and unregulated mobile grid market segments.

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